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List of Abbreviations

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<th>Sr. No.</th>
<th>Abbreviation</th>
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<td>1</td>
<td>DEC</td>
<td>Departmental Elective Course</td>
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<td>8</td>
<td>SEC</td>
<td>Science Elective Course</td>
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<tr>
<td>9</td>
<td>BSC</td>
<td>Basic science Course</td>
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Program Education Objectives (PEOs):

1. To provide students with sound applied knowledge in Metallurgy and Materials Science.
2. To provide students with a foundation in basic sciences, mathematics and engineering, necessary to formulate, solve and analyze engineering problems.
3. To enable students for successful careers in metallurgical, manufacturing industry that meet the needs of Indian and multinational companies and prepare them for higher studies.
4. To provide hands-on experimental skills, to work as part of team necessary for a professional life to work on multidisciplinary projects.
5. To promote student awareness of the life-long learning and to introduce them to professional ethics and codes of professional practice.
6. To develop the students' abilities in communicating technical information and knowledge in both written and oral form.

Program Outcomes (POs):

a. Graduates will demonstrate basic knowledge in mathematics, science and engineering.

b. Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.

c. Graduates will demonstrate the ability to perform experiments in metallurgy, characterization and proper material selection.

d. Graduates will demonstrate the ability to function on engineering and science laboratory teams, as well as on multidisciplinary projects.

e. Graduates will demonstrate the ability to identify, formulate and solve metallurgy and material science problems.

f. Graduates will demonstrate an understanding of their professional and ethical responsibilities.

g. Graduates will be able to communicate effectively in both verbal and written forms.

h. Graduates will have the confidence to apply engineering solutions in global and societal contexts.

i. Graduates should be capable of self-education and clearly understand the value of lifelong learning.

j. Graduates will be broadly educated and will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.

k. Graduates will be familiar with modern engineering software tools and equipment to analyze metallurgy and material science problems.
B.TECH. RULES and REGULATIONS
For the Award of B. Tech. Degree
(Applicable from the academic year 2013-14)

1. **Short Title and Commencement:**
   
   (a) These Regulations shall be called the “College of Engineering, Pune Regulations for the Award of B. Tech. Degree”.
   
   (b) They shall come into effect from the date of getting approval from the Board of Governors of the College.
   
   (c) They shall be applicable for all students enrolling for B. Tech. Degree programmes at the College from Academic year 2013-14.

2. **Definitions:**
   
   (a) “B. Tech.” means Bachelor of Technology, an Under Graduate Degree awarded from the University;
   
   (b) “Board” means Board of Governors of the college;
   
   (c) “College” means College of Engineering, Pune;
   
   (e) “Dean” means Dean of the College, with the specific functions also indicated along with the title;
   
   (g) “Director” means Director of the College;
   
   (h) “Government” means Government of the Maharashtra;
   
   (j) “Regulations” means College of Engineering, Pune Regulations for the Award of B. Tech. Degree;
   
   (k) “Senate” means Senate of the College;
   
   (l) “University” means University of Pune;

3. **Preamble:**

   The Regulations prescribed herein have been made by the College, an autonomous institution under the University, to facilitate the smooth and orderly conduct of its academic programmes and activities at the B. Tech level. It is expected that the Regulations will enable the students to take advantage of the various academic opportunities at the College and prepare themselves to face the challenges in their professional careers ahead. It may be noted that:

   (a) The provisions made herein shall be applicable to all the B. Tech. Programmes offered at the College, at present;
   
   (b) They shall also be applicable to all the new B. Tech. Programmes which may be started at the College in the future;
   
   (c) Academic and non-academic requirements prescribed by the Senate have to be fulfilled by a student for eligibility to the B. Tech. Award;
4. **Academic Calendar:**

**Table 1: Suggested Breakdown of Academic Year into Semesters**

<table>
<thead>
<tr>
<th>1. No. of Semesters/Year</th>
<th>Three; Two being Main Semesters (Odd and Even) and One being a Supplementary Semester; (Note: Supplementary Semester is primarily to assist weak and/or failed students through make up courses, wherever possible. However, the College may use this Semester to arrange Add-On Courses for other students and/or for deputing them for practical training elsewhere.)</th>
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<td>2. Semester Durations:</td>
<td>Main Semesters: 19 Weeks each; Supplementary Semester: 8 Weeks;</td>
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<td>3. Academic Activities (Weeks):</td>
<td>Main Semester (Odd or Even) Registration of Courses- 0.5; Course work- 15.5; Examination Preparation-1.0; Examinations- 1.0; Declaration of Results-1.0; Total: 19; Supplementary Semester (only for makeup Courses): Registration of Courses- 0.1; Course Work- 7.0; Examination Preparation-0.2; Examinations- 0.2; Declaration of Results- 0.5; Total: 8; Inter-Semester Recess: After each Main Semester- 2; After Supplementary Semester- 2; Total: 14 (for good students) and 6 (for weak students)</td>
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*(Note: In each Semester, there shall be provision for students for Registration of Courses at the beginning, Dropping of Courses in the middle under the advice of Faculty Members and approved by Departmental Undergraduate Programme Committee (DUPC).*
4. Examinations:
Continuous Internal Evaluation (CIE) and Semester End Examination (ESE), both having weightage in the students performance in Course Work/Laboratory Work and other activities;
(Note: The CIE shall be conducted throughout the Semester on dates announced in advance and its results made known to the students from time to time. This would be of help to the students to decide on Dropping or Withdrawal from Courses in consultation with their Advisors. However, the dates for the ESE shall be fixed at the College level.

5. Other Items:

- Care shall be taken to ensure that the total number of days for academic work are > 180/year;
- Academic schedules prescribed shall be strictly adhered to by all the Departments;
- Supplementary Semester shall be mainly for Make up Courses, to benefit weak or failed students to the extent possible;
- Students failed in a course after re-examination shall attend a Course fully when it is offered again, and appear for all components of evaluation;
- Specified Min. /Max. Course load per Semester shall be followed at all times.

(a) Each academic year shall be divided into two main semesters, each of 19 weeks, viz., odd semester (Jul. – Dec.) and even semester (Dec. – Apr.), and an 8-week supplementary semester (Apr.-Jun.).
(b) The College shall arrange regular academic activities for the students during the two main semesters and makeup and other courses for the students during the supplementary semester;
(c) The academic activities in a semester shall normally include course registration, course work, continuous internal evaluation, dropping/withdrawal from courses, semester-end examination, and declaration of results.
(d) The College shall announce the schedule for all the academic activities well before the commencement of the academic year and take all the necessary steps to follow them scrupulously.
(e) The college shall also announce adequate intra-semester and inter-semester breaks for the students and ensure that a minimum of 180 academic working days are available during the academic year.
(f) A typical breakdown of the academic year for the B. Tech programme at the College shall be as suggested in Table 1.
5. **Admissions:**

(a) The intake capacity of each programme, including the number of seats to be reserved for students of different categories shall be decided by the Board by following the Government directives and Council approvals.

(b) Admissions to the first year of all the programmes shall be made before the start of each academic year, through the Maharashtra Combined Entrance Test (MHCET) conducted by the Government.

(c) The College shall also admit to first year of the programmes, a limited number of students of Non-Resident Indian (NRI), Persons of Indian Origin (PIO) and Foreign National categories, as per Government rules.

(d) There shall also be a merit-based, lateral admission of students having Diploma qualification to the second year of all the programmes at the College in accordance with the Government rules applicable for such admissions.

(e) The College reserves the right to revoke the admission made to a candidate, if it is found at any time after admission that he/she does not fulfill all the requirements stipulated in the offer of admission.

(f) The College also reserves the right to cancel the admission of any student and discontinue his/her studies at any stage of studentship for unsatisfactory academic performance and/or undisciplined conduct.

6. **Residence:**

(a) Interested students may apply for hostel accommodation at the time of admissions, as the College is partially residential and it can admit a limited number of men and women students in the hostels.

(b) The method of admission to students’ hostels, rent payable per each seat allotted and the discipline to be followed by the residents shall be governed by “rules and regulations” framed by the College in this behalf.

(c) Each student selected for hostel admission shall be provided a seat in one of the hostel rooms identified for this purpose and there shall be no family accommodation available in the hostel for married students.

(d) Students residing in the hostels shall adhere to the prescribed hostel discipline and pay the hostel/mess charges regularly, as any failure to do so, may lead to withdrawal of hostel facilities to such students.

(e) Hostel residents shall apply for leave of absence and get the same approved before leaving the hostel even for a few days, as any failure to do so may lead to cancellation of hostel admission to such students.

(f) Students residing in the hostels shall be required to clear all the hostel dues and vacate their rooms at the end of each academic year, as they will be considered for hostel admission afresh for the New Year.

7. **Attendance:**

(a) Each student shall be required to attend at least 75 per cent of all the classes arranged like, lectures, tutorials, laboratories, studios and workshops for
being permitted to attend the semester-end examination.

(b) Extra Academic Activities (EAC) like Yoga, NSS, Physical Training, NCC and, Boat Club shall be compulsory for students of the first year, with at least a minimum attendance of 75 percent in each of them.

(c) Students shall also be required to take part in any other academic and non-academic activities and attend the camps, as and when arranged by the College during the academic year.

(d) Students desirous of leave of absence for less than two weeks during a semester shall apply for it in advance to the Head of the Department giving reasons & supporting documents, if any and get it approved.

(e) Absence due to illness or any other reason for a period less than two weeks in a semester, for which a student could not make prior application, may be condoned by the Head of the Department after proper verification.

(f) The Dean, Academic Affairs shall be the Authority for sanctioning the leave of students outside clauses (4) and (5) above, after receiving their applications along with recommendations of the Heads of Departments.

(g) In the case of long absence of a student in a semester with prior approval or otherwise, the Dean, Academic Affairs shall decide whether the student be asked to withdraw from the programme for that particular semester.

(h) In all the cases of leave of absence as per Clauses (4)-(6) above, the period of leave taken shall not be condoned for the purposes of fulfilling the attendance requirements stipulated in the Clauses (1) and (2).

(i) It shall be the responsibility of a student residing in the hostel to intimate the Warden of his/her hostel and also the concerned course instructors regarding his/her absence before proceeding on leave.

8. Conduct and Discipline:

(a) All students shall be required to conduct themselves in a manner befitting the students of a national institution of high reputation, within and outside the precincts of the College.

(b) Unsocial activities like ragging in any form shall not be permitted within or outside the precincts of the College and the students found indulging in them shall be dealt with severely and dismissed from the College.

(c) The following additional acts of omission and/or commission by the students within or outside the precincts of the College shall constitute gross violation of code of conduct punishable as indiscipline:

   i. Lack of courtesy and decorum, as well as indecent behaviour;
   ii. Willful damage of property of the College/Hostel or of fellow students;
   iii. Possession/consumption/distribution of alcoholic drinks and banned drugs;
   iv. Mutilation or unauthorized possession of library material, like books;
   v. Noisy and unseemly behaviour, disturbing peace in the College/Hostel;
   vi. Hacking in computer systems, either hardware or software or both;
vii. Any other act considered by the College as of gross indiscipline.

(d) In each case above, the punishment shall be based on the gravity of offence, covering from reprimand, levy of fine, expulsion from Hostel, debar from examination, rustication for a period, to outright expulsion.

(e) The reprimanding Authority for an offence committed by students in the Hostels and in the Department or the classroom shall be respectively, the Rector of the Hostels and the Head of the concerned Department.

(f) In all the cases of offence committed by students in jurisdictions outside the purview of Clause (5), the Dean, Students Affairs shall be the Authority to reprimand them.

(g) All major acts of indiscipline involving punishment other than mere reprimand, shall be considered and decided by the Chairman, Students Disciplinary Committee appointed by the Senate.

(h) All other cases of indiscipline of students, like adoption of unfair means in the examinations shall be reported to the Dean, Academic Affairs, for taking appropriate action and deciding on the punishment to be levied.

(i) In all the cases of punishment levied on the students for any offence committed, the aggrieved party shall have the right to appeal to the Director, who shall constitute appropriate Committees to review the case.

9. **Change of Branch:**

(a) Change of branch shall be permissible for a limited number of special cases in the third semester as per following regulations.

(b) Only those students who have completed the common credits required in the first two semesters in their first attempt with a minimum CGPA of 8.5 shall only be eligible for making application for a change of branch. The students whose admission is based on Tuition Fee Waiver Scheme, PIO’s, and BTech. Planning are not allowed for the branch change.

(c) There shall be a maximum number of only two students admitted in any discipline in the third semester through the branch change rule.

(d) Intending students eligible for change of branch shall apply for the same to the Office of Academic Affairs of the College before the closing date notified at the beginning of odd semester of each academic year.

(e) Such students shall be required to indicate up to three branches, in order of preference to which they wish to change over, as the change shall be strictly based on their merit, subject to availability of vacancies.

(f) The change of branch shall be permitted purely on inter-se merit of all the eligible applicants. The CGPA of students at the end of the second semester shall be considered for rank ordering of the applicants seeking change of branch and in the case of a tie, the MHCET ranks shall also be considered.

(g) All the changes of branch permitted for intending students as per the above clauses shall be effective from their third semester only and no further change of branch shall be permitted after this.
(h) All the changes of branch permitted at this stage shall be final and binding on the applicants and no student shall be permitted, under any circumstances, to refuse the change of branch offered.

(i) The candidates who have sought admission under Tuition Fee Waiver Scheme are not eligible for the branch change.

10. **Course Structure:**

a) Each course offered in the B. Tech. curriculum at the College shall be listed by using a total of five/six digits, the first two being letters and the remaining being numerals, as follows:

   i. The first two letters to represent the Department offering the Course in abbreviated form, e.g., CE for Civil Engineering;

   ii. The first numeral that follows to represent the year of the programme, such as 1, 2, 3 and 4, leading to 100-400 series;

   iii. The next two numerals to represent the Course Number allotted for the subject by the Department, i.e., 01, 02, 03, up to 99;

   iv. Thus, as an example, courses offered at the Department of Civil Engineering could be listed from CE 101 up to CE 499 or based on the automated subject numbering system implemented in MIS;

b) All the courses in the B. Tech. Curriculum shall be unitized, with one credit being assigned to each unit of course work, after the student completes its teaching-learning process successfully.

c) The assignment of credits to course work shall follow the well accepted practice at leading institutions, with one credit being defined to mean:

1. Lecture course conducted for one hour per week in a semester;

2. Tutorial conducted for one hour per week in a semester;

3. Laboratory/Practical conducted for two/three hours per week in a semester;

4. Project work conducted for two hours per week in a semester;

d) Each student for the B. Tech, Degree award shall be required to earn a total of 180 credits during his/her *student* ship at the College. While a student can register for more than 180 credits at the College, only 180 credits shall be reckoned for the Degree award. On the other hand, a student having less than 180 credits shall have to earn the remaining credits to make up the total to 180 credits so as to qualify for the Degree award. The total number of credits earned to complete the course depends on the academic schema for which the student has enrolled for.

e) In addition to the credit requirement prescribed above for the Degree award, each student shall have to complete the requirements of Extra Academic Activities (EAA) as referred to earlier in Clause 2 of Section 7, during the first two semesters of the programme. All the students shall receive certification as PP (for Passed), and NP (for not passed) in EAA, in the Grade Card. While obtaining certification as PP is a mandatory requirement for the Degree award of a student, this shall not be taken
into account for computing the final Grade Point Average.

1. Each student shall register for an average of 22 credits per semester during his/her studentship at the College, with the minimum and maximum credits being fixed as 16 and 28 credits per semester respectively. The exact number of credits to be registered by a student in a semester in a particular Department shall be decided by his/her Faculty Advisor based on the student’s academic performance in the preceding semester and approval by the Departmental Undergraduate Programme Committee (DUPC).

2. The medium of instruction for course work and examinations at the College shall be English. The course work for the Programme shall be broadly divided into six main subject groups, as follows:
   - Humanities & Social Sciences;
   - Professional Science Courses
   - Basic Sciences including Mathematics;
   - Basic Engineering Sciences & Practice;
   - Professional Subjects;
   - Liberal Learning Courses

3. The total course package for the Programme at a Department shall have the following components:
   - Institutional Core subjects
   - Departmental Core subjects
   - Departmental Elective subjects
   - Other Elective subjects

f) The DUPC shall be responsible for planning the curriculum and syllabi for all the courses included for the Programme for approval by the Senate. However, the Institutional Undergraduate Programme Committee (IUPC) shall be in charge for College wide implementation of course work, time tables and related requirements for the Programme.

g) Each Department shall have the flexibility to include industrial training and/or field work of 8 weeks for all its students as a compulsory requirement for the Degree award and this can be assigned credits, as approved by the Senate. However, these shall be arranged during the supplementary semester period following the sixth semester of studies at the College.

h) Each Department shall assign Faculty Advisors for all its students in consultation with the Dean, Academic Affairs and Dean, Students Affairs. It shall be the responsibility of the Faculty Advisors to help the students in planning their course work and other academic activities at the Department and also to regularly monitor and advise them on their academic and other performance at the College. For students of the first two semesters in any Department, the Dean, Students Affairs may assign Faculty Advisors from among the faculty of Basic Science including Mathematics and HSS Departments.
11. Registration of Courses:

(a) Each student shall be required to register for course work by following the advice of the Faculty Advisor at the commencement of each semester on the day fixed for such registration and notified in the Academic Calendar.

(b) Students who fail to register for course work on the notified day may be permitted by the Department for late registration on another day announced in the Academic Calendar after payment of an additional fee fixed by the College.

(c) Only those students shall be permitted to register for course work who have:
   i. Cleared all dues of the College, Hostel and Library including fines (if any) of the previous semester,
   ii. Made all the required advance payments towards the College and Hostel dues for the current semester before the closing date, and
   iii. Not been debarred from registration of courses on any other specific ground.

(d) Each student shall fulfill the following conditions at the time of registration of course work in any semester:
   i. Each student of the first year shall register for all the courses in the first two semesters, with flexibility to drop one/two courses up to the minimum permissible limit of 18 credits in each case. Similarly Direct Diploma students will also register for all courses in third and fourth semester.
   ii. A student shall be permitted to register for more than the average course load, i.e., up to a maximum of 28 credits, if he/she has shown outstanding performance in course work in the previous semesters, i.e., CGPA > =8.0.
   iii. On the other hand, a student whose performance is not so good in the preceding semesters, i.e., <=5.0, shall be permitted to register 18 credits, the students who have secured CGPA in between 5 and 6 are allowed for normal credits (i.e. The credits offered by the department in that semester) and the students who have secured more than 6 CGPA are allowed to register for one additional course. The students are mandatorily required to register for backlog subjects first. The faculty advisor is required to check for the pre-requisites if any at the time of registration.
   iv. Students having CGPA less than 5 at the time of admission to 7th Semester, shall not be allowed to register for the next year subjects / project work till their CGPA/SGPA improves above 5 respectively.
      - In case of student clearing all subjects till sixth semester of B. Tech with CGPA < 5, he/she will be allowed for grade improvement in odd semester of final year.
      - For grade improvement, student will have to take 3 subjects in which he/she has secured DD or CD grades from the same semester in one stretch.
      - Student can choose three subjects from a particular semester offered for T.Y B.Tech (odd semester) in which he/she has secured DD or CD grade. Student will have to register for these subjects in VII semester in which
those subjects are offered. He/she will not be allowed to take up project work.

- In such cases if student improves his/her CGPA he/she will be allowed to register as a special case, for the project work in odd/even semester of Final Year of B. Tech.

(e) All the students shall note the following special features of the credit system, which shall be strictly followed at the College:

i. ESE shall be conducted for the course once in a semester, except to meet the needs of students specially permitted by the College.

ii. A student shall have to re-register in all the failed courses (i.e., Getting Grade FF after summer term/re-examination) at any further semester when they are offered again, freedom being given to the student to change the course only if it is an elective.

iii. Also, a student getting certification as NP in the Extra Academic Activities (EAC), shall re-register for them in a following semester/s until he/she obtains certification as PP.

(f) A student shall have the possibility to drop a course in the middle of a semester as per the Academic Calendar, without mention in the Grade Card, with the concurrence of the Faculty Advisor, and after intimating the concerned course instructor/s and the academic section. However, it shall not be possible for a student to register for an alternative course in that semester.

12. **Supplementary Semester:**

(a) Departments shall have the flexibility to conduct supplementary semesters for FY BTech. courses only during summer months, as per the Academic Calendar. Such a semester shall be offered on the recommendation of DUPC and with the approval of the Dean, Academic Affairs. A student shall be allowed to register for a maximum of three subjects in a supplementary semester. There is re-examination for the FY BTech. Students. No summer term or re-examination will be floated for the laboratory courses.

(b) The supplementary semester shall be utilized primarily to facilitate the failed students to attend the courses in which they have failed and not for launching any new courses for credit. However, a Department shall be free to arrange any Add-On courses for its students during this semester.

(c) The academic activity in the supplementary semester shall be at double the rate as compared to a normal semester; e.g., 1 credit of course work shall require two hours/week in the class room, so that the contact hours are maintained the same as in a normal semester. It shall also be necessary to fulfill the requirements of CIE and ESE for all the courses like in a normal semester.

(d) Courses planned for the supplementary semester shall be announced by the Dean, Academic Affairs in each year, well before the conclusion of the even semester. Students intending to avail of this facility shall have to register for the courses offered by paying the prescribed fees within the stipulated time.
(e) It shall be the responsibility of the Department to plan in advance the faculty and non-teaching staff requirements to conduct the supplementary semester and take necessary steps including the institutional approvals for organizing the same.

(g) The student who are either dropped or detained in the course/s during regular semester is not allowed to register for that course/s in summer.

(h) Re-exam (ONLY for 60 marks equivalent to end semester exam) shall be conducted for all other classes three weeks after grade approval by DUPC. The re-exam shall be conducted after every semester, for all subjects offered in that semester. For final grading, T1, T2 scores of respective semester shall be used. Grade ranges shall be same as that of regular semester for that subject.

(i) The students those who have passed in the re-examination will be awarded grade report with * marked on the subjects passed in re-examination.

13. Programme Duration:

(a) The Programme duration for a student to complete the academic and other requirements at the College and qualify for the award of Degree by the University shall be normally 8 semesters.

(b) However, it shall be possible for an outstanding student to qualify for the Degree award in less than eight semesters, by registering for more number of credits i.e., up to the maximum permissible limit of 28 credits per semester from the third semester onwards to complete the Programme requirements of 180 credits. In such a case, the College shall issue a Provisional Certificate to the student who shall await the completion of eight semesters for the Degree award by the University.

(c) This flexibility shall also enable academically weaker students to conduct their studies at a slower pace and complete their Degree requirements in more than eight semesters. The maximum duration for the course completion will be 12 semesters.

(d) Clause (3) above shall be applicable to two types of students at the College:
   i. Those wishing to complete the Degree requirements comfortably without encountering failure in any course;

(e) In both the above cases, a student shall have to complete the Programme requirements for the Degree of 180 credits within 12 semesters. Failure to complete the Programme requirements by any student in this period shall lead to the cancellation of his/her admission to the College forthwith. The Senate on case to case basis on the recommendations of the Director and Dean-Academics can extend the term.

(f) A student will not be awarded degree if his/her CGPA at the end of the course is less than 5. For such students the performance improvement scheme is recommended wherein he/she is eligible to take any three subjects for the improvement.
14. **Temporary Withdrawal:**

(a) Student shall be permitted to withdraw temporarily from the College on the grounds like prolonged illness, grave calamity in the family or any other serious happening. The withdrawal shall be for periods which are integral multiples of a semester, provided that

i. He/She applies to the College within at least 6 weeks of the commencement of the semester or from the date he/she last attended the classes, whichever is later, stating fully the reasons for such withdrawal together with supporting documents and endorsement of his/her guardian.

ii. The College is satisfied that, even by taking into account the expected period of withdrawal, the student has the possibility to complete the Programme requirements of 180 credits within the time limits specified earlier.

iii. The student shall have settled all the dues or demands at the College including those of Hostel, Department, Library and other units.

(b) A student availing of temporary withdrawal from the College under the above provision shall be required to pay such fees and/or charges as may be fixed by the College until such time as the students name appears on the Roll List. However, it shall be noted that the fees/charges once paid shall not be refunded.

(c) Normally, a student shall be entitled to avail of the temporary withdrawal facility only once during his/her studentship of the Programme at the College.

15. **Termination from the Programme:**

A student shall be required to leave the College on the following grounds

i. Absence from classes for more than six weeks at a time in a semester without leave of absence being approved by the competent authorities, shall result in the student’s name being struck off the College rolls.

ii. Failure to meet the standards of discipline as prescribed by the College from time to time shall also result in the student being recommended by the Students Disciplinary Committee to leave the College.

16. **Performance Assessment:**

(a) There shall be achievement testing of all the students attending a course, like lecture course, laboratory/design/drawing course or a combination of the two. This shall be in two parts, as follows, both of them being important in assessing the students performance and achievement in the particular course:

1. **Sessional,** involving Continuous Internal Evaluation (CIE), to be normally conducted by the subject teacher all through the semester; This shall include mid-term tests, weekly/fortnightly class tests, home work assignments, problem solving, group discussions, quiz, seminar, mini-project and other means. The subject teacher shall announce the detailed methodology for conducting the various segments of CIE together with their
weightages at the beginning of the semester.

2. **Terminal**, often designated as **End Semester- Examination (ESE)**, to be conducted by the subject teacher, preferably jointly with an external examiner; This shall include a written examination for theory courses and practical/design/drawing examination with built-in oral part for laboratory/design/drawing courses.

3. **CIE** and **ESE** shall have 40:60 weightage. A student’s performance in a subject shall be judged by taking into account the results of CIE and ESE together.

   - From the Academic Year 2013-14 there will be only two continuous evaluation examinations and ESE. The weightage for these evaluations will be T1 (20%), T2 (20%) and End-Semester (60%). Dean academics will declare the tentative schedule of these examinations in the academic calendar. Exact dates for ESE and common subjects/Open electives for T1 and T2 will be declared by Controller of Examination in consultation with Dean Academics. The administration of T1 and T2 (except common subjects/Open electives) will be at department level.

   - In case of absentee for T1, T2, and End-Semester Examination, student will have to seek permission of Dean Academics to appear for Re-examination. This permission will not be a privilege and will be decided on a case to case basis. If any student participates in any of the events on behalf of the institute, he/she will inform in advance in writing to Dean Academics with recommendation from Dean Students Affairs.

   - If any of the students misses T-1 or T-2 for genuine reasons and re-examination is not to be conducted, then his/her end-Semester performance will be appropriately weighted to account for the loss of T-1 or T-2. If any student misses both T-1 and T-2 then no proportionate ratification in marks will be done and his marks in end-semester examination will be considered for final grades.

   - Legitimate reasons for re-examination will be as follows:
     - Illness on or immediately before the exam date (may include the critical illness of a close family member); bereavement i.e. death of someone in a close relationship with the student; or a sufficiently crowded exam schedule (technically, 3 or more End Sem exams in one day).

4. The evaluation of the project work shall be based on Sessional Work assigned by the project supervisor, seminar presentation, project report and assessment by Project Evaluation Committee, as covered in Clause(7) later in this Section.

5. In the case of other requirements, such as, seminar, comprehensive viva voce and EAA the assessment shall be made as determined by the Grade Awarding Authority of the College.

6. While the conduct of CIE for a course shall be the responsibility of the subject teacher and the Department concerned, and ESE shall be conducted centrally by the Examination Section of the College. The records of both CIE and ESE
shall be maintained by the Examination Section.

7. The performance of students at every stage of the CIE shall be announced by the concerned subject teacher within a fortnight of the date of the particular assessment. The subject teacher shall also show the assessed answer books to the students before submission of the final marks to the Controller of Examinations.

8. The concerned subject teacher shall also be responsible to award letter grades to the students after the ESE is completed and to submit the final results of the course within one week of the last date of ESE to the Controller of Examinations through the Head of his/her Department.

(b) Question Papers: For being able to conduct achievement testing of the students in an effective manner, good question papers shall be used as the principal tool, making it necessary for the question papers at CIE and ESE to:

i. Cover all sections of the course syllabus uniformly;

ii. Be unambiguous and free from any defects/errors;

iii. Emphasize knowledge testing, problem solving & quantitative methods;

iv. Contain adequate data/ other information on the problems assigned;

v. Have clear and complete instructions to the candidates.

(c) Therefore, the question papers, particularly at ESE, shall be set covering the entire syllabus and the students given opportunity to answer questions from the full syllabus of the course by restricting their choice out of each unit in the syllabus.

(d) Besides, the course syllabi shall be well drafted, be defect-free and properly unitized (or modularized) to enable the distribution of questions in the question papers to cover the whole syllabus. These aspects shall have to be taken into account, in particular, by the concerned DUPCs.

(e) There shall be two types of questions to be set by the subject teacher for the question papers at both CIE and ESE, viz.,

i. **Multiple Choice Questions**, having each question to be answered by tick marking the correct answer from the choices (commonly four) given against it. Such a question paper shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students. Usually, no more than 15-20% of the questions in a paper for CIE or ESE shall be of this type.

ii. **Comprehensive Questions**, having all questions of the regular type to be answered in detail. Such a question paper shall be useful in the testing of overall achievement and maturity of the students in a subject, through long questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation.

(f) Examinations: The College shall maintain a high standard in both CIE and ESE and ensure the declaration of final results including SGPA and CGPA of the courses attended by a student in a semester before the end of the semester as per the Academic Calendar. For meeting these requirements, the College shall take the following steps:

i. CIE shall be conducted exclusively by the subject teacher, who shall spell out the components of CIE in advance, maintain transparency in its
operation, declare the evaluation results in time and return the answer scripts and assignment sheets to the students on a regular basis after the evaluation is completed. The teacher shall also solve the questions asked in the tests at the tutorial sessions for the benefit of weak students.

ii. ESE shall be preferably conducted jointly by the subject teacher and an external examiner appointed for this purpose by the College. In this case, considering the time schedule for the various tasks connected with ESE, the external examiner shall be associated with the teacher only in the setting of the question paper.

iii. The answer scripts of ESE shall be evaluated by the subject teacher only; but, an external review of the entire ESE shall be conducted under the aegis of the Board of Examiners of the College before declaring the results. This step shall be useful to the College to gain the confidence of the University on the fairness and transparency in the system.

iv. Suggested passing standard for each of the courses shall be 50% of the topper marks from the CIE and ESE taken together.

v. Attendance at all examinations, both CIE and ESE of each course shall be compulsory for the students. Students having the following deficiencies shall not be permitted to attend the ESE:

A. Disciplinary action by the College pending against him/her;
B. Irregular in attendance at lecture/laboratory and other classes;
C. Failure to meet the standards of attendance prescribed;
D. CIE Performance far below the passing standard

(g) In the event of a final year student failing in a Laboratory course or scoring very low marks in the CIE of a subject or falling seriously ill during ESE, the subject teacher concerned shall have the discretion to grant the student extra time, not exceeding 12 weeks for satisfactorily completing the concerned course after awarding an I grade. If no such extra time is sought/granted, the concerned student shall have to re-register for the same in a succeeding semester and take steps to fulfill the requirements for the Degree award. The I grade shall be required to be converted into a regular grade within stipulated period indicated in the academic calendar.

(h) There shall be make-up examination for a course to take care of students with the I or X grades in ESE.

(i) Make Up Examination: This facility shall be available to students who may have missed to attend the ESE of one or more courses in a semester for valid reasons and given the I grade; also, students having the X grade shall also be eligible to take advantage of this facility. The makeup examination shall be held as per dates notified in the Academic Calendar. However, it shall be possible to hold a makeup examination at any other time in the semester with the permission of the Dean, Academic Affairs. The standard of conducting this examination shall be the same as the normal ESE.

(j) Evaluation of Project work: The project work shall be normally conducted in two stages, spread over one or two sequential semesters.
i. At the end of first stage, the student shall be required to submit for evaluation, a preliminary report of the work done before a prescribed date to the Project Coordinator, DUPC and present the same before an Internal Project Evaluation Committee. This shall be followed by taking up the second stage of work either in the same or the following semester.

ii. The Controller of Examinations shall receive a panel of names from the Chairman, DUPC for identifying the project examiners for the student, at least two weeks before the submission of the second stage of project work. This shall comprise of three unbound, typed copies of the project report (one for each examiner), prepared according to the prescribed format to be submitted to the Department at least one week before the date of oral examination.

iii. The Department shall record the date of submission of the project report and arrange to send copies of the same to the examiners a few days before the date fixed for the oral examination. The project coordinator shall notify the date of the oral examination to the examiners and also the student, with a copy marked to the Controller of Examinations. Then the project report shall be evaluated by the Project Evaluation Committee and the result submitted to the Project Coordinator, who in turn shall forward it to the Controller of Examinations.

iv. On successful completion of the oral examination, the student shall be required to submit two bound copies of the final, corrected project report, one being for the Department and the other for the project supervisor(s).

v. A student desirous of extension of time, up to a maximum of 3 months from the prescribed date for submission of the project report, shall seek permission for the same from the Project supervisor(s) and Head of the Department. The DUPC shall consider such requests, case by case, before giving the permission.

vi. If the DUPC is convinced that the progress of a student in project work is insufficient, the concerned students shall be temporarily awarded the I grade. Further, if the project report of the student is not submitted within the extended time period, the I grade shall be automatically converted to the FF grade.

vii. Such of the students who fail in the first stage assessment of project work shall be required to re-register for the first stage in the following semester. Likewise, those who obtain the FF grade in the second stage assessment shall be required to re-register for the same in the subsequent semester(s).

(k) The evaluation of performance in EAA’s shall be done by the concerned faculty members, who shall communicate the student’s performance to the Examination Section, soon after the examination is conducted.

17. Grading System:

(a) The College shall follow the award of letter grades and the corresponding grade points to the students based on their performance at the end of every semester, as given in Table 2. In addition to the grades given in the Table 2, the instructors shall use two transitional grades I and X as described in Clause (3) in this Section.
Table 2: Letter Grades and Grade Points

<table>
<thead>
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<th>Grade</th>
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<tbody>
<tr>
<td>AA</td>
<td>10</td>
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<td>4</td>
</tr>
<tr>
<td>FF</td>
<td>0</td>
</tr>
<tr>
<td>PP</td>
<td>0</td>
</tr>
<tr>
<td>(Only for Compulsory Non Credit Subjects)</td>
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</tr>
</tbody>
</table>

| AU (Audit Subject) | 0 |
| NP (Only for Non Credit Subjects) | Not Passed |

(b) A student is considered to have completed a course successfully and earned the credits if he/she secures a letter grade other than I, ‘X’ or FF in that course. Letter grade FF in any course implies failure in that course.

(c) The Transitional Grades I and ‘X’ shall be awarded by the teachers in the following cases:

i. Grade I to a student only on satisfactory attendance at classes and performance in other components of assessment, but absence from ESE in a semester for valid and convincing reasons acceptable to the Department, such as,
   A. Illness or accident, which disabled him/her from appearing at the examination;
   B. A calamity in the family at the time of the examination, which required the student to be away from the College;
ii. Grades X to a student on his/her overall performance in the course during the semester, highly satisfactory, i.e., high CIE rating, but a very low ESE performance resulting in an overall FF Grade in the course.
iii. All the I and X grades awarded to the students shall be converted by the teachers to appropriate letter grades and communicated to the Academic Section (through Head of the Department) within two days of the respective make-up ESEs. Any outstanding I and X grades two days after the last scheduled make-up ESEs shall be automatically converted to FF grade.

(d) A Semester Grade Point Average (SGPA) shall be computed for all the students in a Department for each semester, as follows:
SGPA = \(\frac{C_1 \times G_1 + C_2 \times G_2 + C_3 \times G_3 + \ldots + C_n \times G_n}{C_1 + C_2 + C_3 + \ldots + C_n}\)

where, \(n\) is the number of courses registered during the semester, \(C_i\) is the number of credits allotted to a particular course, and \(G_i\) is the grade points corresponding to the grade awarded for the course.

(e) A Cumulative Grade Point Average (CGPA) shall be computed for all the students in a Department at the end of each semester by taking into consideration their performance in the present and the past semesters as follows:

\[
CGPA = \frac{C_1 \times G_1 + C_2 \times G_2 + C_3 \times G_3 + \ldots + C_m \times G_m}{C_1 + C_2 + C_3 + \ldots + C_m}
\]

where, \(m\) is the number of courses registered upto that semester, \(C_i\) is the number of credits allotted to a particular course, and \(G_i\) is the grade points corresponding to the grade awarded for the course.

(f) Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such for ease of presentation. Whenever the CGPAs are to be used for the purpose of determining the merit ranking in a group of students, only the rounded off values shall be made use of.

(g) When a student gets the grade I or X for any course during a semester, the SGPA for that semester and the CGPA at the end of that semester shall be tentatively calculated ignoring the I and X graded course(s). The SGPA and CGPA for that semester shall be finally recalculated after conversion of I and X grade(s) to appropriate grade(s), taking into account the converted grade(s).

(i) Other academic requirements for the Programme include the following two certifications as indicated earlier in clause (5) of Section 10, viz., PP (Passed) and NP (Not Passed) for EAA. However, there shall be no grade points are associated with these certifications and they do not figure in the calculation of SGPA or CGPA. But, obtaining a PP shall be a mandatory requirement to qualify for, the Degree award.

(j) It shall be open to each student to take additional courses for audit from the fifth semester onwards, with the concurrence of the Faculty Advisor. Students having CGPA \(\geq 8.0\) shall be normally encouraged to take such courses. While the performance of the student in audited courses shall be included in the Grade Card, they do not contribute to SGPA or CGPA of the concerned student.

18. **Method of Awarding Letter Grades:**

(a) The subject teacher(s) shall award the letter grade(s) to students based on the marks secured by them in both CIE and ESE together in the course(s) registered. This shall be done by following a relative grading system based on the use of statistics, for which the IUPC shall make available an appropriate software package.

(b) The subject teacher(s) shall submit two copies of the result sheet for each course, giving both the marks and the grades awarded to the Head of the Department, before the due date specified in the Academic Calendar. This shall be forwarded to the Controller of Examinations soon thereafter by the Head of the
Department, after preliminary scrutiny and moderation (if necessary) at the DUPC level.

(c) All the evaluated answer scripts of CIE in a subject shall be returned to the students from time to time during the semester. However, the answer scripts of ESE shall only be shown to the students during the specified period after the evaluation and the detailed marks sheets together with the ESE answer scripts and any other relevant papers connected with ESE shall be submitted by the subject teacher(s) to the Controller of Examinations who shall hold it for a period of at least one semester. Steps shall be taken to destroy the same only after obtaining permission from the Dean of Academic Affairs at the end of the prescribed period.

(d) Appeal: A student shall have the possibility to appeal to the Director against a subject teacher for awarding lower grade in a course than that expected by him/her, on payment of prescribed fees, before the commencement of the next semester. In such a case, the DUPC shall arrange a meeting of the aggrieved student together with a Committee comprising of the subject teacher, another subject expert from the College and the Head of the Department, who shall reconsider the evaluation done, show the answer script to the student. If the student is satisfied, the matter shall be closed at this stage. On the other hand, if a revision of marks allotted is called for, the same shall be carried out and all the records, including the Grade Card, corrected soon thereafter. In the latter case, the prescribed fee paid by the student shall be returned.

(e) Witholding of Grades: The Grades of a student in a semester shall be withheld and not declared if the student fails to pay the dues to the College or has disciplinary action pending against him/her.

19. **Eligibility for the Award of Degree:**

(a) A student shall be eligible for the award of B. Tech. Degree from the College and the University provided:

i. Completed all the prescribed credit requirements for the award of Degree with grade DD or higher, in each of the courses, like Theory, Laboratory, Studio, Workshop, Seminar and Project Work;

ii. Satisfactorily completed all the non-credit requirements with PP certification, covering EAA and Industrial Training, Field work, (if any);

iii. Obtained a CGPA of $\geq 5.00$ at the end of the semester in which he/she completes all the requirements for the award of Degree;

iv. Paid all the dues to the College including the Department, Hostels, Library and other units; and,

v. No case or disciplinary action pending against him/her.

(b) The Senate shall be the Recommending Authority for the award of B. Tech. Degree to students fulfilling the requirements specified under Clause (a) above and the Board shall be the Approving Authority.

(c) The Degree award shall then be granted by the University.
20. **Eligibility for the CGPA improvement after completion of pre-requisite credits for the award of Degree:**

Students who secure CGPA between 5 and 6.75 after completing the pre-requisite credits for the award of degree, and wish to improve their CGPA are permitted for CGPA improvement. Such students be permitted to withdraw their grade in a given course with poor grade and permitted to reappear for the examinations for improving the grade and in turn CGPA.

a) Student can appear for grade improvement examination within one year from the date of passing his/her PG or UG Examination. He/she should not have taken (i) Leaving Certificate from the Institute and ii) Degree from University of Pune through convocation. He/she will submit a written application to dean academics seeking his/her permission to register for class improvement within one month from the date of declaration of result or one week before the date of convocation of University of Pune whichever is earlier. This application will be forwarded to dean academics through the Head of the Department from where he/she has graduated. No student will be admitted once the subject registration process of that semester ends.

b) For grade improvement student will have to take maximum 3 subjects in which he/she has secured DD or CD grades from the same semester in one stretch.

c) Student can choose maximum three theory courses from a particular semester offered for T.Y and B. Tech (either odd or even) in which he/she has secured DD or CD grade. Student will have to register for these courses in a particular semester in which those subjects are offered.

d) At the time of registration student will surrender all the original mark lists given to him by the institute He will have to give an affidavit on 100 Rs. judicial stamp paper that he/she will not do any use of surrendered mark lists till he/she gets official result of the subjects for which he/she wishes to appear for grade improvement. No change of subjects or drop of subjects will be allowed after registration.

e) Student wishing to improve his/her grade will have to pay appropriate fees as laid down by the institute time to time.

f) Student wishing to appear for grade improvement is exempted from attending regular classes as he/she has already undergone the course instructions but he/she will have to appear for all the evaluation tests conducted for the particular subjects. No re-exam or retest will be allowed for the class improvement, in case of such students misses any of the tests or examinations. Absentee for End-semester examination will automatically lead to award of FF grade in that subject.

g) The grading process as used for the regular students appearing for that subject will be applicable and no concession of any sort will be granted on account of absentee for any of the examinations.

h) Student wishing to use the facility of grade improvement will have to pass in all the three subjects at a time for which he/she has registered for. He/she will not be entitled for the summer term or re-examination in such cases.
i) Only one attempt will be permissible for any candidate wishing to use the facility of grade improvement. If the student fails to secure higher grades resulting in reduction in overall CGPA then the original result of the student before registering for grade improvement will be retained.

j) Student who improves his/her CGPA will be issued fresh mark lists by the institute. These mark lists will have star against the subjects for which he/she has appeared for grade improvement and will state “Grade Improvement”. The date on the new mark lists will be that as issued for other students appearing in those subjects. Name of the student will be communicated to Pune University and he/she will have to apply for degree certificate from University of Pune thereafter.
### CURRICULUM STRUCTURE OF Final Year B.TECH (Metallurgy)

**Effective from A. Y. 2014-2015**

#### VII Semester

<table>
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<td>Open/Science elective/Humanities</td>
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*Department Elective: Nano-materials & Nanotechnology
Powder Metallurgy
Laser Materials Processing

#### VIII Semester

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*Department Elective: Surface Engineering
Wire Technology
Forging Technology
Ceramic Engineering
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<td>OEC</td>
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<td>3 L 0 T 0 P</td>
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<td>01</td>
<td>OEC</td>
<td>Failure analysis of Engineering Materials</td>
<td>3 L 0 T 0 P</td>
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Design and Selection of Materials

**Teaching Scheme**
- Lectures: 3 hrs/week
- Tutorial: 1 hr/week

**Examination Scheme**
- 100 marks: Continuous evaluation-
  - Quiz/Assignment – 40 marks
  - End Sem exam – 60 marks

**Unit 1**
(6 hrs)
Materials in Design, Evolution of Engineering Materials, Design process, Types of design, Design flow chart- tools and material data, Interaction between Function, Material, Shape and Process

**Unit 2**
(6 hrs)
Revision of engineering materials and properties, Material properties interrelationship charts such as Young’s modulus-density, Strength-density, Young’s modulus-Strength, wear rate-hardness, Young’s modulus – relative cost, strength-relative cost and others

**Unit 3**
(6 hrs)
Materials selection, selection strategy: material attributes, translation of design requirements, screening attribute limits, ranking by indices, search supporting information, Local conditions, method of finding indices, Weighted-Properties Method, computer aided selection, structural index; Case studies: table legs, flywheel, springs, elastic hinges, seals, pressure vessels, kiln wall, passive solar heating, precision devices, bearings, heat exchangers, airframes, ship structures, engines and power generation, automobile structures

**Unit 4**
(6 hrs)
Materials Substitution, Pugh Method, Cost–Benefit Analysis, Cost basis for selection, causes of failure in service, Specifications and quality control, Selection for static strength, toughness, stiffness, fatigue, creep, corrosion resistance, wear resistance, material databases

**Unit 5**
(6 hrs)
Process selection, ranking processes, cost, computer based process selection, Case studies: fan, pressure vessel, optical table, cast tables, manifold jacket, spark plug insulator

**Unit 6**
(6 hrs)
Selection under multiple constraints, conflicting objectives, penalty-functions, exchange constants, Case studies: connecting rods, windings of high field magnets, casing of minidisk player, disk-brake caliper
Text Books:


Reference Books:


Outcomes:

- Students will understand the basic design process and its relation to material selection.
- Students will understand interpretation of mechanical properties of materials, and apply these material properties in the design of components.
- When data such as stress and strain is given, students will be able to determine the mechanical properties of materials, and apply these material properties in the design system components.
- Students will develop the skills to make informed engineering material selection decisions that will be safe and economic.
- Students will be able to explain the interrelationship between design, function, materials and process.
- To select and use appropriate industrial literature and library resources in the solution of material selection.
Corrosion and Surface Protection

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1 (7 hrs)

Unit 2 (8 hrs)
Various Forms of Corrosion Such as Uniform Corrosion, Galvanic Corrosion, Crevice Corrosion, Pitting Corrosion, filliform corrosion, Intergranular Corrosion, Selective Leaching, Erosion Corrosion, Stress corrosion cracking (SCC), Environmental assisted cracking (EAC), fretting damage, Hydrogen Damage, corrosion fatigue, hydrogen embrittlement and microbes induced corrosion.

Unit 3 (7 hrs)

Unit 4 (7 hrs)

Unit 5 (7 hrs)
Corrosion Testing by Physical and Electrochemical Methods. Use of ASTM standards like G-8, G-5, G-1, A262 etc. NACE standards / their equivalents, Surface Preparation, Exposure Technique salt spray, cyclic corrosion test, weatherometer, immersion test, Corrosion Rate Measurements. Few case studies.

Text Books:

Reference Books:
L.L. Shreir- Corrosion Volume I & II, Butterworths, London, 1994,
NPTEL website

Outcomes:

- Able to establish correlation between thermodynamic and corrosion.
- Able to solve numerical.
- Concepts and fundamentals in corrosion.
- Knowledge of material selection for different corrosive environments.
- Knowledge of corrosion prevention methods.
- Knowledge of testing methods & standards.
Electronic and Magnetic Materials

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment –40 marks
End Sem exam – 60 marks

Unit 1
(6 hrs)

Unit 2
(6 hrs)
Semiconductors, Extrinsic, Intrinsic, Semiconductor Devices, Compound Semiconductor, Microelectronic Devices Such as LED, CMOS, MOSFETS, BPT etc, Manufacturing Methods and Applications.

Unit 3
(6 hrs)

Unit 4
(6 hrs)

Unit 5
(6 hrs)

Unit 6
(6 hrs)
Text Books:


Reference Books:


Outcomes:

- Students get insights into structure - property relationship of modern electrical engineering materials and come to know how this relationship can be used for design of the materials for commercial applications.
- Students get exposure to the innovations taking place on the fronts of the synthesis, processing and applications of modern electrical engineering materials.
- Students get prepared for taking advanced post graduate courses in the areas of Materials Science and Engineering.
Dept. Elective: Nano-materials & Nanotechnology

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1 (6 hrs)
Definition, Length scales, surface area/volume ratio of micron to nanoscale materials, Importance of Nanoscale and Technology, Top down and bottom up approaches, Classification of nanomaterials, Properties of selected nanomaterials including carbon nanotubes (CNT), graphene, metal nanoparticles, clays, nanowires, quantum dots (QDs), effect of size on thermal, mechanical and electrical properties of nanomaterials etc.

Unit 2 (6 hrs)
Fabrication of Nanomaterials: Top-down approaches-lithography, grinding/milling, Bottom-up approaches-chemical vapour deposition, physical vapour deposition, atomic layer deposition (ALD), and Sol-gel method, Synthesis and purification of CNT, synthesis of expanded graphite (EG) or graphene etc.

Unit 3 (6 hrs)
Fabrication of nanocomposites: Fabrication of Clay-rubber, Clay-polymer, CNT-polymer, EG-polymer, magnetic particle-polymer, CNT-metal, trade off between the composites and nanocomposites etc.

Unit 4 (6 hrs)
Characterization of Nanomaterials:, X-ray diffraction (XRD), Laser particle size analyzer, Scanning electron microscope (SEM), Transmission Electron Microscope (TEM), UV-Visible spectroscopy, Scanning probe microscopy- Atomic force microscope (AFM) and scanning tunneling microscope (STM).

Unit 5 (6 hrs)
Applications of nanomaterials: Electronics, structural, biomedical, sensors nanofluids, optical, magnetic, biomedical fields, solar cells, LED, LCD, electrically conducting polymers, batteries, fuel cells, SMART materials etc.

Unit 6 (6 hrs)
Challenges of nanomaterials, Effect of nanomaterials on health: pros and cons, Recent advances in nanoscience and nanotechnology.

Text Books:

**Reference Books:**


**Outcomes:**

- Student will be able to know the length scale and surface area to volume ratio of materials with decreasing size of particles.
- Student will be able to compare the properties of nanomaterials to that of bulk.
- Students will be able to know the effect of particles or grains size on mechanical, thermal, optical and electrical properties of nanomaterials.
- Students will be able to synthesis the nanomaterials by top-down and bottom up approaches.
- Students will be able to understand the theoretical concepts of synthesis, purification and applications of carbon nanotubes.
- Students can also modify the nano-clay particles.
- Students will be able to apply the knowledge to prepare and characterize nanomaterials and their nanocomposites.
- Students will be able to know characterization of nanomaterials using x-ray diffraction, laser particle size analyzer, transmission electron microscope (TEM) etc.
- Students will be able to understand the theoretical concepts of the applications of nanomaterials in structural, electronics, optical, magnetic and bio-medical fields, nanocomposites etc.
Dept Elective: Powder Metallurgy

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1 (6 hrs)

Unit 2 (6 hrs)
Characterization and Testing of Metal Powders: Sampling, Particle Size and Distribution- Sieve Analysis, Light Scattering, Sedimentation, Microscopy and Image Analyzer, Chemical Analysis of Metal Powders, Surface Area, Density and Porosity of Metal Powder, Apparent and Tap Density of Metal Powder, Flow Rate, Compressibility and Green Strength.

Unit 3 (6 hrs)

Unit 4 (6 hrs)
Sintering: Different Stages of Sintering and Development of Microstructures During Sintering, Different Mechanisms of Sintering, Liquid Phase Sintering and Activated Sintering, Sintering Furnaces and Furnace Atmospheres.

Unit 5 (6 hrs)
Application:
Detailed Study on Processing of any 03 Components used in following applications: Bearing Materials, Tool Materials, Ferrites, Cermets, Friction Materials, Medical and Dental Applications, Nuclear Applications, Automotive Applications.

Unit 6 (6 hrs)
Text Books:

- F.Thumler and R. Oberacker –Introduction to Powder Metallurgy, 1993

Reference Books:

- Gopal S. Upadhyaya - Powder Metallurgy Technology, Cambridge International
- Rehamann, Processing of Ceramics and Sintering 2nd edition, 2007

Outcomes:

- The student will be able to learn the Powder Manufacturing methods,
- The student will be able to know the powder and finished PM product’s characterization techniques,
- The student will be able to understand the powder conditioning and consolidation methods to obtain the finished products
- The student will be able to comprehend various methods of consolidation and the secondary operations performed on PM parts
- The student will be able to develop awareness on manufacturing and applications of a few important P/M components: properties and their dependence on processing and microstructure.
Dept Elective: Laser Materials Processing

**Teaching Scheme**
Lectures: 3 hrs/week

**Examination Scheme**
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

### Unit 1
(6 hrs)
Industrial lasers, construction, CO₂ laser, Solid state lasers, Diode laser, Excimer laser, disc and fibre laser, Comparison of lasers.

### Unit 2
(6 hrs)
Interaction of lasers with materials, reflection, absorption, Laser beam optics and characteristics – wavelength, coherence, mode and beam diameter, polarization; effect of wavelength, temperature, surface films, angle of incidence, materials and surface roughness, Spot size, focus, lens doublets, depolarizers, collimator, metal optics, scanning systems, fiber delivery systems.

### Unit 3
(6 hrs)
Heat flow theory: one-dimensional model, stationary point source models, moving point source models, Keyhole model, models for flow and stress

### Unit 4
(12 hrs)

### Unit 5
(6 hrs)
Laser safety, standards, safety limits, laser classification

**Text Books:**

**Reference book:**
- Metals Handbook, ASM, Metals Pak, OH 44073
- Powell J. ‘CO₂ Laser cutting’, Carl Hanser Verlag, Munich

**Outcomes:**
Newly floated course – Outcomes N/A yet...
OEC: Selection of Materials and Processes

Teaching Scheme
Lectures: 3 hrs/week
Tutorial: 1 hr/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1
(6 hrs)
Interaction between Function, Material, Shape and Process, Revision of engineering materials and properties, Material properties interrelationship charts such as Young’s modulus-density, Strength-density, Young’s modulus-Strength, wear rate-hardness, Young’s modulus – relative cost, strength-relative cost and others

Unit 2
(6 hrs)
Materials selection, selection strategy: material attributes, translation of design requirements, screening attribute limits, ranking by indices, search supporting information, Local conditions, method of finding indices, Weighted-Properties Method, computer aided selection, structural index

Unit 3
(6 hrs)
Case studies related to automotive, aerospace, ship building and telecommunication industries: flywheel, springs, elastic hinges, seals, pressure vessels, kiln wall, passive solar heating, precision devices, bearings, heat exchangers, airframes, ship structures, engines and power generation, automobile structures

Unit 4
(6 hrs)
Materials Substitution, Pugh Method, Cost–Benefit Analysis, Cost basis for selection, causes of failure in service, Specifications and quality control, Selection for static strength, toughness, stiffness, fatigue, creep, corrosion resistance, wear resistance, material databases

Unit 5
(6 hrs)
Process selection, ranking processes, cost, computer based process selection, Case studies: fan, pressure vessel, optical table, cast tables, manifold jacket, spark plug insulator

Unit 6
(6 hrs)
Selection under multiple constraints, conflicting objectives, penalty-functions, exchange constants, Case studies: connecting rods, windings of high field magnets, casing of minidisk player, disk-brake caliper
Text Books:


Reference Books:


Outcomes:

- Students will understand the basic design process and its relation to material & process selection.
- Students will understand interpretation of mechanical properties of materials, and apply these material properties in the design of components and processes.
- Students will develop the skills to make informed engineering material & process selection decisions that will be safe and economic.
- Students will be able to explain the interrelationship between design, function, materials and process.
- To select and use appropriate industrial literature and library resources in the solution of material & process selection.
Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous assessment &
Term Work - 70 Marks
End Sem exam - 30 Marks

A Set of 08 Number of Experiments Based on the Theory Syllabus.

1. Measurement of potential of various metals (Fe, Cu, Zn etc.)
2. pH measurement
3. Crevice corrosion in stainless steel
4. Intergranular corrosion of austenitic stainless steel
5. Use of inhibitors in preventing corrosion
6. Hot dip zinc coating for corrosion prevention
7. Weight loss method for corrosion rate determination
8. Salt spray exposure
9. Cyclic corrosion test
10. Stress corrosion cracking (U bend test)
11. Polarization and Electrochemical Impedance Study
12. Characterization by optical, SEM, XRD method

Outcomes:

- Able to establish correlation between theory and practical.
- Able to conduct actual practical independently.
- Hands on experience of practical.
- Knowledge of interpreting results.
- Able to solve numerical involved in practical.
- Knowledge of testing procedure & use of standards.
- Ability to carry multidisciplinary projects.
Powder Metallurgy Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous assessment &
Term Work - 70 Marks
End Sem exam - 30 Marks

Topics:
1. Powder Milling in Planetary ball mill
2. Powder characterization - Particle size analysis and its distribution, apparent and tap density, angle of repose, flow rate.
3. Powder conditioning – lubricant and binder addition
4. Powder Compaction and green density measurement
5. \( \text{H}_2 \) Sintering of compacts
6. Sintering microstructures
7. Microhardness measurement on sintered specimens
8. Measurement of wear Properties
9. Structure – property correlation

Outcomes:
Students completing this course satisfactorily will have
- Basic knowledge of milling of ductile powder materials
- Knowledge of characterization of powder particle size analysis and its distribution and its flow and frictional properties
- Knowledge of compaction and sintering cycles adapted while powder processing.
- Understanding of reading the powder microstructures, measurement of microhardness and wear properties
- Understanding of establishment of structure – property correlation
The B. Tech. Project is aimed at training the students to analyze independently any problem in the field of Metallurgical Engineering and Material Science. The project may be analytical, computational, experimental or a combination of the three in a few cases. The project report is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical, computational, experimental aptitude of the student. The progress will be reviewed in two stages - in the middle of the two semesters (Project I) and at the end of second semester (Project II). In the final stage, it will be externally evaluated on the basis of oral/seminar talk.

Outcomes:

- This course teaches the student to how to do literature survey and locate the problems.
- Students demonstrate the ability to design experiments independently in metallurgy
- Students will demonstrate the ability to function on engineering and science laboratory in teams, as well as on multidisciplinary projects.
- Students develop an able to communicate effectively in both oral and written forms.
**OEC  Failure analysis of Engineering Materials**

**Teaching Scheme**
Lectures: 3 hrs/week

**Examination Scheme**
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

**Unit 1**
(6 hrs)
Failure mode, failure modes observed in practice, failure analysis and methodology, tools and techniques of failure analysis, failure experience matrix, Procedural steps involved in failure investigations.

**Unit 2**
(6 hrs)

**Unit 3**
(6 hrs)
Fatigue failures, cyclic stress and strain controlled fatigue, fatigue life estimation, micro structural aspects of fatigue failure, use of fracture mechanics, fatigue life improvement.

**Unit 4**
(6 hrs)
Elevated temperature failures, creep mechanisms, creep life estimation, deformation mechanism map, creep resistant materials.

**Unit 5**
(6 hrs)
Wear failures, Abrasive and adhesive wear, wear mechanism map, materials having high wear resistance.

**Unit 6**
(6 hrs)
Failure mechanisms in electronic materials and devices, nature of failure mechanisms investigations, approaches to achieving high reliability.

**Reference Books:**
- Materials Science and Technology for Design Engineers Edited by Alex E. Javitz, Hayden Book Company, India, 1979

**Outcomes:**
- Students will make aware of the failure mechanisms involved in the service of engineering components and devices.
Materials Joining

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1 (6 hrs)

Unit 2 (6 hrs)

Unit 3 (6 hrs)

Unit 4 (6 hrs)
Chemical Reactions in Welding, Gas-Metal, Slag-Metal Reactions, Metal Evaporation, Residual Stresses, Distortion, Fatigue of Welded Joints.

Unit 5 (6 hrs)
Fusion Zone, Solidification, Effect of Cooling Rate, Partially Melted Zone, Liquation, Heat Affected Zone, Defects in Welded Joints, Micro-Segregation, Macro-Segregation, Banding, Gas Porosity, Inclusions, Weld Metal Cracking, Liquation Cracking, Hydrogen Cracking.

Unit 6 (6 hrs)

Text Books:


Reference books:

Outcomes:
• Students will have ability to apply knowledge of mathematics, science, and engineering.
• Students will understand how to design and conduct experiments, as well as to analyze and interpret data.
• Students will be able to identify, formulate, and solve engineering problems related to welding.
• Students will have skills to communicate effectively.
• Students will have ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
• Students will have ability to select and design welding materials, processes and inspection techniques based on application, fabrication and service conditions.
• Students will be able to identify the defects in welded joints and perform the failures analysis and report in professional manner.
Fracture and Failures Analysis

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1 (6 hrs)
Fatigue: Cyclic Loading, Cyclic stress and cyclic strain controlled fatigue, Fatigue life estimation of notched components, Fatigue Initiation Mechanism, Factors affecting Fatigue Life,

Unit 2 (6 hrs)
Crack Growth, Fatigue Failure, Second Order Terms, Predicting Direction of Crack Growth, Crack Closure, and Corrosion Fatigue.

Unit 3 (6 hrs)

Unit 4 (6 hrs)
Crack Tip Plasticity, Plastic Zone Size and Shape, Elastic Plastic Failure, Plane Strain Fracture Toughness, Design for Fracture Mechanics, Test Procedures for Kc, Kic, CTOD& J.

Unit 5 (6 hrs)

Unit 6 (6 hrs)
Wear: Types: Abrasive Adhesive, Oxidative, Corrosion, Erosion, Fatigue, Mechanism of Wear Particle Formation and Wear tests, Failure analysis: Methodology and case studies

Text Books:

Outcomes:
- Students develop an ability to apply metallurgical principles in failure analysis.
- Students get basic knowledge of fracture mechanics
- Students get insights for selection of materials for engineering applications
Dept Elective: Ceramic Engineering

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment –40 marks
End Sem exam – 60 marks

Unit 1 (6 hrs)
Introduction to bonding, important ceramics structures, point defects, defect reactions, diffusion and defects.

Unit 2 (6 hrs)
Ceramic powder processing and forming – Solid state and viscous sintering, Herrings-Scaling law, stress in densification and sintering stress; Grain growth and Ostwald ripening, grain growth kinetics, pore-grain boundary interactions.

Unit 3 (6 hrs)
Novel techniques like spray pyrolysis, solgel process etc., near net shape forming, gel casting, slip, tape, gel casting, plastic forming, thick films and thin films, Multilayer ceramic technology –processing and sintering of multilayer structure. Low temperature co-fired glass ceramics.

Unit 4 (6 hrs)
Structural ceramics, deformation behaviour and toughening of ceramics, toughening mechanism, crack deflection, bridging, shielding, pullout, Zirconia Ceramics: Crystal structure and polymorphic modifications, transformation toughening; effect of microstructure, different system in zirconia (PSZ, TZP, ZTA, ZTC), Weibull parameters

Unit 5 (6 hrs)
Ceramics in tribological and thermal applications: scope, material requirements, fabrication and applications, wear components, ceramic cutting tools, ceramic coatings, Surface melting and Thermo chemical treatments, Thermal properties, high strength and high temperature strength, thermal stresses and fracture, applications.

Unit 6 (6 hrs)
Glass and glass-ceramics: Structural models, theory of glass formation, Homogeneous and heterogeneous nucleation and crystal growth, TTT diagram, toughening of glass, optical properties, Glass ceramics- fabrication, advantages of glass ceramic formation, properties and applications.

Text Books:


Outcomes:

• The student will be able to learn the ceramic processing techniques to get finished products,
• The student will be able to understand the chemistry and structure of ceramic materials,
• The student will be able to read the microstructures of glass and advanced (modern structural and electrical) ceramics.
• The student will be able to know the properties of ceramics, and their dependence on processing and microstructure.
Dept Elective: Surface Engineering

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1
(6 hrs)
Introduction to surface engineering, Scope of surface engineering in metals, ceramics, polymers and composites, Surface Preparation methods such as Chemical, Electrochemical, Mechanical- Sand Blasting, Shot peening, Shot blasting, Hydroblasting, Vapor Phase Degreasing etc.

Unit 2
(6 hrs)
Chemical Conversion Coating: Chromating, Phosphating, Anodizing, thermochemical processes, industrial practice, economy and energy considerations.

Unit 3
(6 hrs)
Metallic coating: Surface pretreatments, Hot Dipping, galvanizing, Electrolytic, electrophoretic deposition and Electroless plating of important metals and alloys, testing / evaluation of surface properties, Thermal spraying. Continuous coating processes for sheets and coils.

Unit 4
(6 hrs)
Coating from Vapour Phase: PVD, CVD, Various Methods used, mechanisms, important reactions involved and applications.

Unit 5
(6 hrs)
Plasma Coating: Sputtering, Plasma Spray & Ion Implantation Methods, mechanisms & applications.
Surface modification by directed energy beams like ion, electron and laser beams, novelty of composition and microstructures.

Unit 6
(6 hrs)

Text Books:

Reference Books:


Outcomes:

The Learning Outcomes are assessed through assignments in the form of numerical, case study, quizzes, mid-semester and a final exam. Since the course is a multidisciplinary type useful for the students in taking multidisciplinary projects. Experiments involving surface modification is required to be performed by student and graded by the instructor.

- Understood importance of surface modification.
- Theoretical concepts and fundamentals in surface modification.
- Knowledge of surface modification for different application in metallurgical, mechanical, electronics, optical industries.
- Able to solve numerical.
- Knowledge of testing methods & standards.
Dept Elective: Wire Technology

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Quiz/Assignment – 40 marks
End Sem exam – 60 marks

Unit 1
Brief revision of hot rolling, mechanical working, cold work and work hardening, solid solution strengthening, effect of alloying elements on work hardening of steel. The Stelmor cooling process, TTT & CCT Diagrams.

Unit 2

Unit 3
Effect of processing parameters on mechanical properties of wire – effect of carbon and other alloying elements on work hardening, effect of microstructure, drawing strain – total and stepwise, strain rate, lubrication and cooling efficiency.

Unit 4
Heat Treatments and their effects on microstructures and mechanical properties – patenting, annealing, stress relieving, quenching and tempering.

Unit 5

Unit 6
Applications of wires and their basic principles – electrical conductor wire, tire cord, mechanical springs, wire ropes. Brief introduction to other metallic wires – copper, aluminium, and tungsten.

Text Books:

- Ferrous Wire – Volume 1 and 2, The Wire Association International
- Physical Metallurgy Principles, Reed-Hill, 2nd ed, East West Press, New Delhi, 1973
- Research Articles from Technical Publications and Conferences.
Outcomes:

- Students will have ability to apply knowledge of mathematics, science, and engineering
- Students will understand how to design and conduct experiments, as well as to analyze and interpret data
- Students will be able to identify, formulate, and solve engineering problems related to wire drawing
- Students will have skills to communicate effectively
- Students will have ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- Students will have ability to select and design processes and inspection techniques based on application, fabrication and service conditions
- Students will be able to identify the defects in wire products and perform the failures analysis and report in professional manner
Dept Elective:  Forging Technology

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
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<tbody>
<tr>
<td>Lectures: 3 hrs/week evaluation-</td>
<td>100 marks: Continuous</td>
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<tr>
<td>Quiz/Assignment –40 marks</td>
<td>End Sem exam – 60 marks</td>
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**Unit 1** (6 hrs)
Fundamentals of forging, merits of forged components over castings, selection of forging equipments – hammers and presses, allied forging processes – up – setting, open die forging, close die forging, upsetting, ring rolling, cross rolling, hammers

**Unit 2** (6 hrs)
Die Manufacturing techniques, die materials for hammers and presses, basic die design, knowledge of engineering software.

**Unit 3** (6 hrs)
Load calculations in forging, safety requirements for hammers and presses, noise, heat, vibration and pollution monitoring and control in forging industry

**Unit 4** (6 hrs)
Design and selection of different material grades commonly used in forging industry, destructive and non destructive testing of forged components – chemical, mechanical, flow lines, microstructure, hardness etc.

**Unit 5** (6 hrs)
Finishing operations for forging, energy sources for hot forging: oil, gas and electricity, lubrication in forging, die failure and die care, distortion, heat treatment for forging, thermo-mechanical processing for forging

**Unit 6** (6 hrs)
Forging defects, quality systems and tools for root cause analysis of defects, measuring instruments used in die production and forging inspection, instrumentation technology in furnaces, compressors and induction heaters

**Reference Books:**
- ASM Metals Handbook, Forming and Forging, Vol. 14, ASM Internationals, Metals Park, Ohio, USA
- Forging Practices, G.G. Kamenshchikov, S. Koltun, V. Naumov, B. Chernobrovkin, Foreign Languages Publication House, Moscow, Russia
- Materials Forming Technology: Die Design and Forging, Alwyn Thomas, UK
Outcomes:
- Students will develop the in depth understanding of forging technology
- Students will learn different processes and material grades pertaining to forging technology in metallurgical industries
MATERIALS JOINING LABORATORY

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous assessment & Term Work - 70 Marks
End Sem exam - 30 Marks

Minimum 8 assignments from the following areas are required to be completed.

1. Working on welding machines for different welding processes such as manual arc welding, MIG welding, TIG welding, Spot welding,
2. Diffusion welding of two dissimilar metals,
3. Case studies of welding defects, application of NDT and remedies
4. Soldering and brazing practice
5. Measurement of hydrogen in weld metal of welded steels

Outcomes:

- Students will have ability to apply knowledge of mathematics, science, and engineering.
- Students will understand how to design and conduct experiments, as well as to analyze and interpret data.
- Students will be able to identify, formulate, and solve engineering problems related to welding
- Students will have skills to communicate effectively
- Students will have ability to select and design welding materials, processes and inspection techniques based on application, fabrication and service conditions.
- Students will be able to identify the defects in welded joints and perform the failures analysis and report in professional manner
PROJECT II

Teaching Scheme | Examination Scheme
---|---
Interaction: 12 hrs/week | Oral - 100 Marks

The B. Tech. Project is aimed at training the students to analyze independently any problem in the field of Metallurgical Engineering and Material Science. The project may be analytical, computational, experimental or a combination of the three in a few cases. The project report is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical, computational, experimental aptitude of the student. The progress will be reviewed in two stages - in the middle of the two semesters (Project I) and at the end of second semester (Project II). In the final stage, it will be externally evaluated on the basis of oral/seminar talk.

Outcomes:
- This course teaches the student to demonstrate their knowledge in science and engineering.
- Students demonstrate the ability to perform experiments independently in metallurgy, characterize and can propose proper material and/or process selection.
- Students will demonstrate the ability to function on engineering and science laboratory in teams, as well as on multidisciplinary projects. Students understand professional and social responsibilities.